Maisie's Department Store
MDP Example

author

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┌─────────────────────────────┐
│     Problem Description      ▐
└─────────────────────────────▐
```

The manager of Maisie's Dept. Store has to decide how
much advertising copy to place in the local Sunday
newspaper; in particular, he can choose either light
(L) or heavy (H) coverage. He classifies weekly sales
into 3 categories: Average (A), Above Average (AA),
and Below Average (BA), and believes that the current
week's sales depend on both the previous week's sales
and the advertising level.

Light advertising coverage costs 100, and Heavy coverage
costs 300. The weekly return from sales (excluding
advertising costs) are
    AA) above average: 1200
     A) average: 1000
    BA) below average: 900

We wish to find an advertising strategy that maximizes
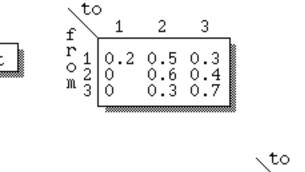the average weekly net return (including advertising
costs).

# of states: 3
# of actions: 2

```
                                    ┌─────────────┐
                                    │ Cost Matrix ░│
                                    └─────────────┘░
                                      ░░░░░░░░░░░░░░░

                                    1      2      3
                    |k| name    ┌──────────────────────┐
                    |1| Light   │ ⁻1100   ⁻900   ⁻700  │
                    |2| Heavy   │  ⁻900   ⁻700   ⁻500  │░
                                └──────────────────────┘░
                                  ░░░░░░░░░░░░░░░░░░░░░░░░
```

(Rows ~ actions, Columns ~ states)

*(minimizing the negative of
the expected profit.)*

Transition Probabilities

Action: Light

```
           to
            1     2     3
   f
   r   1 │ 0.2   0.5   0.3
   o   2 │ 0     0.6   0.4
   m   3 │ 0     0.3   0.7
```

Action: Heavy

```
           to
            1     2     3
   f
   r   1 │ 0.6   0.3   0.1
   o   2 │ 0.4   0.5   0.1
   m   3 │ 0.2   0.7   0.1
```

LP Tableau

Maisie's Dept. Store

k:	1	2	1	2	1	2	R H S
i:	1	1	2	2	3	3	
Min	-1100	-900	-900	-700	-700	-500	
	0.8	0.4	0	-0.4	0	-0.2	0
	-0.5	-0.3	0.4	0.5	-0.3	-0.7	0
	1	1	1	1	1	1	1

i~state, k~action

Iteration 0

Policy: (Cost= ⁻775)

	State	Action	P{i}
1	AA: above average	2 Heavy	0.475
2	A: average	2 Heavy	0.425
3	BA: below average	2 Heavy	0.1

Basic: ¥   ¥   ¥

k:	1	2	1	2	1	2	rhs
i:	1	1	2	2	3	3	rhs
Min	⁻50	0	⁻25	0	0	0	775
	1.55	1	0.575	0	0.4	0	0.475
	⁻0.35	0	0.725	1	0.2	0	0.425
	⁻0.2	0	⁻0.3	0	0.4	1	0.1

i~state, k~action

Iteration 1

Policy: (Cost= ⁻790.323)

	State	Action	P{i}
1	AA: above average	1 Light	0.306452
2	A: average	2 Heavy	0.532258
3	BA: below average	2 Heavy	0.16129

Iteration 1

Basic: ✻   ✻   ✻

k:	1	2	1	2	1	2	rhs
i:	1	1	2	2	3	3	rhs
Min	0	32.2581	−6.45161	0	12.9032	0	790.323
	1	0.645161	0.370968	0	0.258065	0	0.306452
	0	0.225806	0.854839	1	0.290323	0	0.532258
	0	0.129032	−0.225806	0	0.451613	1	0.16129

i~state, k~action

Iteration 2

Policy: (Cost= ⁻794.34)

	State	Action	P{i}
1	AA: above average	1 Light	0.0754717
2	A: average	1 Light	0.622642
3	BA: below average	2 Heavy	0.301887

Basic: ✻ ✻ ✻

k:	1	2	1	2	1	2	rhs
i:	1	1	2	2	3	3	
Min	0	33.9623	0	7.54717	15.0943	0	794.34
	1	0.54717	0	⁻0.433962	0.132075	0	0.0754717
	0	0.264151	1	1.16981	0.339623	0	0.622642
	0	0.188679	0	0.264151	0.528302	1	0.301887

i~state, k~action